Rec. zool. Surv. India: Vol 119(4)/ 438-443, 2019
DOI: 10.26515/rzsi/v119/i4/2019/145451
ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

Morphological studies on male and female genitalia of *Myrmecaelurus acerbus* (Walker, 1853) (Neuroptera: Myrmeleontidae)

Simarjit Kaur*, K. Rajmohana and Manpreet Singh Pandher

Zoological Survey of India, New Alipore, Kolkata - 700053, India; simarjit485@gmail.com

Abstract

Morphological studies were conducted on male and female genitalia of *Myrmecaelurus acerbus* (Walker, 1853) using light microscopy as well as scanning electron microscopy. Detailed descriptions of the genitalia of both male and female have been given. Three main types of sensilla i.e. sensilla chaetica, sensilla trichoidea and sensilla coeloconica were observed for the first time and their possible role have been discussed.

Keywords: Genitalia, Morphology, Scanning Electron Microscope (SEM), Sensilla

Introduction

Genus *Myrmecaelurus* Costa, 1855 belongs to tribe Myrmecaelurini of family Myrmeleontidae and is represented by four species namely *Myrmecaelurus acerbus* (Walker, 1853), *Myrmecaelurus afghanus* Kimmins, 1950, *Myrmecaelurus implexus* (Walker, 1853) and *Myrmecaelurus zigan* Aspöck, H. *et al*., 1980 in the Indian subcontinent (Chandra & Sharma, 2009; Oswald, 2019). In general, *Myrmecaelurus* larvae are facultative pit-builders, performing both characters of pit-builders and non-pit-builders (Devetak *et al.,* 2013) whereas the adults like other Myrmeleontids, could be encountered in vegetation during early morning or in dusk.

M. acerbus is the most common species found in India. This species was described by Walker in 1853, under genus *Myrmeleon* Linnaeus from North India without mentioning any type locality. However, MacLachlan (1868) included this under the genus *Myrmecaelurus.* According to Krivokhatsky *et al*. (2015) *M. acerbus* is a variable species which varies in size and is polymorphous in the intensity of the mottling of the wing venation even within local population. They synonymized variable forms of this species viz., *M. varians* Navás 1913, *M. aequans* Navás, 1913 and *M. nematicus* Navás, 1932 with *M. acerbus.* This species has been reported from various localities in India i.e. Bihar, Punjab and Western Himalayas (Needham, 1909) and different parts of Rajasthan (Ghosh, 1977).

Although many workers (Walker, 1853; Navás, 1913; Esben-Petersen, 1918-19; Asana & Makino, 1937; Holzel, 1968) have dealt with this species, the present manuscript provides for the first time, a detailed description of both male and female genitalia based on scanning electron microscopic studies. The different types of the sensilla and their possible role have been discussed.

Material and Methods

The adult specimens were collected from different localities of Rajasthan as a part of studies on faunal diversity of Rajasthan Survey programme of ZSI.

The field collected specimens were separated up to species level with the help of keys by Ghosh (2000). The terminology of various structures has been adopted from Badano *et al*. (2017) and Nowińska and Brożek (2017). The morphology of male and female genitalia was studied under stereoscopic microscope as well as Scanning

* *Author for correspondence*

Article Received on: 21.06.2019 Accepted on: 14.08.2019

Electron Microscope (SEM). For the preparation of male and female genitalia, the terminal abdominal segments were removed and put in 10% KOH solution overnight. These were then washed in water and kept in solution of 80% alcohol with a drop of glycerol for observation. They were then either processed for SEM or photography under microscope.

Samples used for SEM were dehydrated in graded series of alcohol and mounted on SEM specimen stubs using a small strip of double-sided adhesive tape. They were then sputter coated with gold and scanned under Zeiss EVO 18 special edition.

Photographs were taken under a stereoscopic zoom microscope Leica M250A with a mounted digital camera Leica DFC 500 and processed with LAS v3.7 software. Finally photographic plates were prepared in Adobe© Photoshop© 10.

Results

Myrmecaelurus acerbus (Walker, 1853)

Myrmeleon acerbus Walker, 1853: 366

Myrmecaelurus acerbus MacLachlan, 1868: 278

Measurements: Forewing, length 24.59- 24.76 mm, breadth 7.51- 7.62 mm; hindwing, length 21.86- 21.92 mm, breadth 6.02- 6.08 mm.

Material examined: Rajasthan, Dry grassland, Sanjeev Kumar and party, 47 (16♀s & 31♂s); Sikar, Nursery near circuit house, 27°36'43.416"N, 75°8'23.856"E, 10.ix.2017, ♀ & ♂ ; Jaipur, Kalakh Dam, 26°57'57.168"N, 75°27'55.584"E, 9.ix.2017, 1♀; Tonk, Pond at Baroni, 26°16'44.904"N, 75°53'39.767"E, 10.vi.2017- H.S. Banyal, 1♀.

Male genitalia (Figure 1-2 & 5-9): Abdominal segment VI and VII with pair of pleuritosquamae, prominent lateral brushes of dense strong bristles (Figure 1 & 6). Sternum VIII with microtrichia on ventral side (Figure 5). Tergum IX almost trapezoidal, sternum IX large with subacute rounded apex equipped with microtrichia, sensilla chaetica (Sch1 type), sensilla trichoidea and strong bristles (Figure 7). Gonocoxites IX and XI strictly associated in complex, being a tube like structure (Figure 2). Gonocoxite IX trilobed with two serrated rows, covered with spoon like projections dorsally (Figure 8). Gonocoxite XI with sensilla coeloconica (Figure 9). Ectoproct with short ventrocaudal projection, covered with microtrichia and sensilla chaetica.

Female Genitalia (Figures 3-4 & 10-13): Gonocoxite VII unpaired, relatively small, round, sclerotized, with microtrichia and sensilla chaetica. Gonocoxite 8 paired, longer than wide, rod shaped with microtrichia, sensilla chaetica (Sch1), sensilla trichoidea and strong bristles (Figure 3 & 11). Tergum IX trapezoidal, gonocoxite IX plate like covered with long bristles (Figure 3 & 4). Ectoproct with very short ventrocaudal projection, covered with microtrichia, sensilla chaetica (Sch1), sensilla chaetica (Sch2 type) which look like digging setae and sensilla trichoidea (Figure 12 & 13).

Discussion

M. acerbus (Walker, 1853) is close to *M. trigrammus* (Pallas) but differs in the subcostal being black, interrupted with yellow, the radius wholly black and some of the other veins also black (MacLachlan, 1868). On the basis of genitalia, they differ in shape of tergum IX, sterum IX, gonocoxites 9 and 11.

Scanning electron microscopic studies have been conducted for the first time, which revealed the presence of three major types of sensilla i.e. sensilla chaetica, sensilla trichoidea and sensilla coeloconica. Apart from this, microtrichia are distributed uniformly on the genitalia. Many workers have highlighted the presence of different of sensilla on insect's terminalia along with their possible role. In general, according to Acebes *et al.*, (2003), sensilla on terminalia are used for the positioning of genitalia for copulation during mating events. In case of female, presence of sensilla play a role in copulation as well as in ovipositional behaviour and have been reported in insects by many workers like Rossignol *et al.* (1977), Seenivasagan *et al.*, (2009), Matushkina and Klass (2011) and Klass and Matushkina (2018).

In *Lype phaeopa* (Trichoptera, Psychomyiidae), Altner and Prillinger (1980) mentioned that sensilla chaetica might be water current receptors estimating whether the oviposition site is permanently supplied with flowing water aerating the egg. In continuation on this, Spänhoff *et al.* (2003) studied different types of sensilla (sensilla chaetica, sensilla trichoidea, sensilla coeloconica and sensilla campaniform) on tip and along the ovipositor of

female of same species and concluded that these sensilla may be interpreted as receptors for tactile stimuli. They help the females in finding suitable oviposition sites. Faucheux (1995) reported sensilla trichodea as important mechanoreceptors in the oviposition of *Homoeosoma* species (Lepidoptera, Pyrallidae). Similar results were found by Faucheux (2012) on *Phoracantha recurva* Newman (Coleoptera: Cerambycidae). Moophayak *et al*., (2017) while studying terminalia of wasp-mimicking fly, *Stomorhina discolor* (Fabricius) reported sensilla trichoidea and sensilla basiconica on male and female genitalia and mentioned their possible role in copulation as well as in ovipositional behaviour.

The present study could observe sensilla chaetica and sensilla trichoidea widely distributed on female genitalia. As perceived in other insect orders, it could be concluded that, these may be involved in initial recognition of the surrounding for oviposition and act as tactile mechanorecptors/ olfactive function/ hygroreceptive function.

In males of tribe Myrmecaelurini, a typical structure i.e. pleuritosquamae on abdominal segemnts VI and VII is very unique. These are prominent lateral brushes of dense setae supported by muscles might play a role in courtship behaviour by volatile secretions (New, 1981). The presence of sensilla coeloconica (peg in pit surrounded by finger-like structures) on gonocoxite XI might have thermoreception or hygroreception functions and help in the courtship behaviour.

An illustrated account of the morphology of the male and female genitalia of *M. acerbus* and of different types of sensilla present, are provided here. All these taxonomic attributes add to a detailed diagnosis of the species and also in understanding its biology.

Acknowledgements

The authors are thankful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata for providing laboratory facilities for this research.

References

Acebes, A., Cobb, M. and Feurler, J. F. 2003. Species-Specific effects of single sensillum ablation on mating position in Drosophila, *Journal of Experimental Biology*, **206**, 3095-3100. https://doi.org/10.1242/jeb.00522. PMid: 12878676.

Altner, H, Prillinger, L. 1980. Ultrastructure of invertebrate chemo-, thermo-, and hygroreceptors and its functional significance, *International Review of Cytology*, **67**, 69-139. https://doi.org/10.1016/S0074-7696(08)62427-4.

Asana, J. J. and Makino, S. 1937. The occurrence of V-shaped centrioles in the spermatocytes of some Neuropteran insects, *Annotationes Zoologicae Japonenses*, **16**, 175-179.

Badano, D., Aspock, H. and Aspock, U. 2017. Taxonomy and phylogeny of the Gymnocnemia Schneider, 1845, and Megistopus Rambur, 1842, with remarks on the systematization of tribe Nemoleontini (Neuroptera: Myrmeleontidae), *Deutsche Entomologische Zeitschrift*, **69**(1), 43-60. https://doi.org/10.3897/dez.64.11704.

Chandra, K. and Sharma, R. M. 2009. Checklist of Indian Neuropterids (Insecta: Megaloptera; Raphidioptera; Neuroptera).

Esben-Petersen, P. 1918-19. Help-notes towards the determination and the classification of the European Myrmeleonidae, *Entomologiske Meddelelser*, **12**, 97-127.

Faucheux, M. J. 1995. Sensilla on the antennae, mouthparts, tarsi and ovipositor of the sunflower moth, *Homoeosoma* electellum (Hulster) (Lepidoptera, Pyralidae): a scanning electron microscopic study, *Annales des Sciences naturelles, Zoologie, Paris 13e Série*, **16**, 121-136.

Faucheux, M. J. 2012. Ovipositor sensilla of the Yellow longicorn beetle *Phoracantha recurva* Newman, 1840 (Coleoptera: Cerambycidae), *Bulletin de l'Institut Scientifique*, **34**(1), 11-18.

Ghosh, S. K. 1977. Fauna of Rajasthan, India- Neuroptera, *Records of the Zoological Survey of India*, **72**, 309-313.

Ghosh, S. K. 2000. Neuropteran fauna of North- East India. *Records of the Zoological Survey of India, Occasional*, Paper No. 184, 1-179.

Holzel, H. 1968. Zur Kenntnis der Myrmeleoniden des Iran (Planipennia, Myrmeleonidae), *Stuttgarter Beiträge zur Naturkunde (aus dem Staatlichen Museum fur Naturkunde in Stuttgart)*, **181**, 1-32. Accessed: 23.04.2019. http://zsi.gov.in/WriteRead/userfiles/file/Checklist.pdf.

Klass, K-D. and Matushkina, N. A. 2018. The exoskeleton of the male genitalic region in archaeognatha with hypotheses on the early evolution and the morphological interpretation of genitalia in insects, *Arthropod Systematics and Phylogeny*, **76**(2), 235-294.

Krivokhatsky, V. A., Dobosz, R. and Khabiev, G. N. 2015. Antlions and owlflies (Neuroptera: Myrmeleontidae, Ascalaphidae) of Kyrgyzstan, *Entomological Review*, **95**(9), 1212-1224. https://doi.org/10.1134/S0013873815090092.

MacLachlan, R. 1868. New genera and species of neuropterous insects, and a revision of Mr. F. Walker's British Museum Catalogue of Neuroptera, part ii. (1853), as far as the end of the genus, The Journal of the Linnean Society of London, **9**, 230-281. https://www.

biodiversitylibrary.org/part/70200#/summary.
Matushkina, N. A. and Klass, K-D. 2011. Morphology of female external genitalia in Phenes raptor (Odonata: Petaluridae), *International Journal of Odonatology*, **14**(3), 199-215. https://doi.org/10.1080/13887890.2011.607735.
Moophayak, K., Sanit, S., Chaiwong, T., Sukontason, K., Kurahashi, H., Sukontason, K. L., Vogtsberger, R. C. and Bunchu, N. 2017. Morphological characteristics of terminalia of the Wasp-Mimicking Fly, *Stomorhina discolor* (Fabricius), *Insects*, **8**(11), 1-8. https://doi.org/10.3390/insects8010011. PMid: 28085083, PMCid: PMC5371939.
Navás, L. 1913. Neuroptera asiatica. I series, *Revue Russe d'Entomologie*, **13**, 271-284.
Needham, J. G. 1909. Notes on the Neuroptera in the collection of the Indian Museum, *Records of the Indian Museum, Calcutta*, **3**,185-210.
New, T. R. 1981. Presence of hair-pencils in acanthaclisine antlions (Neuroptera: Myrmeleontidae), *International Journal of Morphology and Embryology*, **10**(5/6), 373-375. https://doi.org/10.1016/0020-7322(81)90017-9.
Nowińska, A. and Brożek, J. 2017. Morphological study of the antennal sensilla in Gerromorpha (Insecta: Hemiptera: Heteroptera), *Zoomorphology*, **136**, 327-347. https://doi.org/10.1007/s00435-017-0354-y. PMid: 28883684, PMCid: PMC5563518.
Oswald J. D. 2019. Neuropterida Species of the World. Version 6.0. Accessed on 16.03.2019. http://lacewing.tamu.edu/SpeciesCatalog/Main.
Robert M'lachlan, F. L. S. 2008. New Genera and Species, & c., of Neuropterous Insects; and a revision of Mr. F. Walker's British Museum Catalogue of Neuroptera, part II (1853), as far as the end of the genus *Myrmeleon*, *Journal of the Linnaean Society of London, Zoology*, **9**, 230-281. https://doi.org/10.1111/j.1096-3642.1867.tb00195.x.
Rossignol, P. A. and McIver, S. B. 1977. Fine structure and role in behavior of sensilla on the terminalia of Aedes aegypti (L.) (Diptera: Culicidae), *Journal of Morphology*, **151**, 419-437. https://doi.org/10.1002/jmor.1051510307. PMid: 845972.
Seenivasagan, T., Sharma, K.R., Shrivastava, A., Parashar, B.D., Pant, S.C. and Prakash, S. 2009. Surface morphology and morphometric analysis of sensilla of Asian tiger mosquito, Aedes albopictus (Skuse): An SEM investigation, *Journal of Vector Borne Diseases*, **46**, 125-135.
Spänhoff, B., Alecke, C., Kaschek, N., Lange, J. and Meyer, E. I. 2003. Morphological characteristics of sensilla on the female ovipositor of *Lype phaeopa* (Psychomyiidae; Trichoptera), *Journal of Insect Science*, **3**(12), 1-7. https://doi.org/10.1673/031.003.1201.
Walker, F. 1853. List of the specimens of neuropterous insects in the collection of the British Museum. Part II.--(Sialidae--Nemopterides). British Museum, London; p. 193-476. https://lacewing.tamu.edu/Biblio/Record?BibObjID=6194.

Abbreviation

Sch1 - sensillium chaetica type 1; Sch2 - sensillium chaetica type 2; ST- sensillium trichoidea; SCo - sensilla coeloconica.

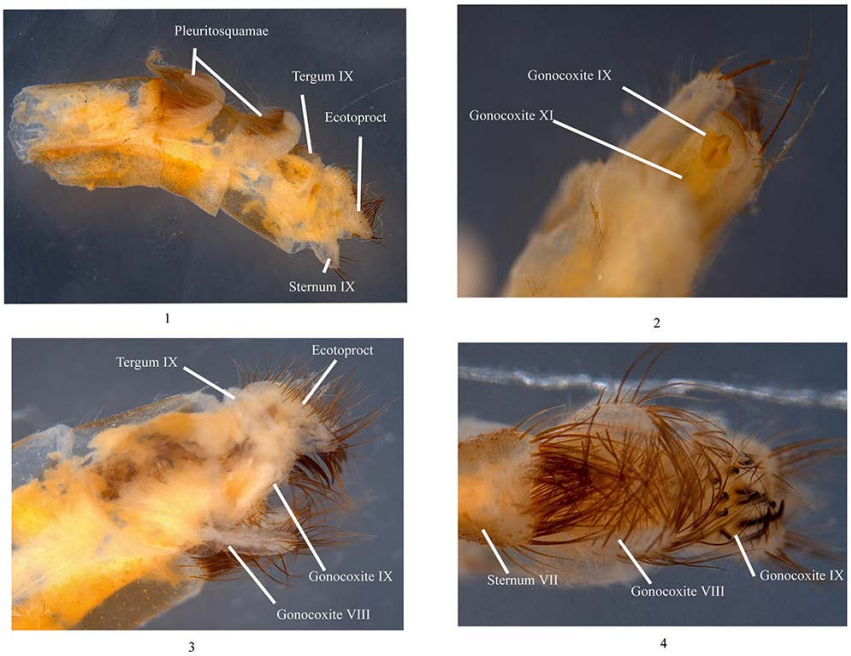
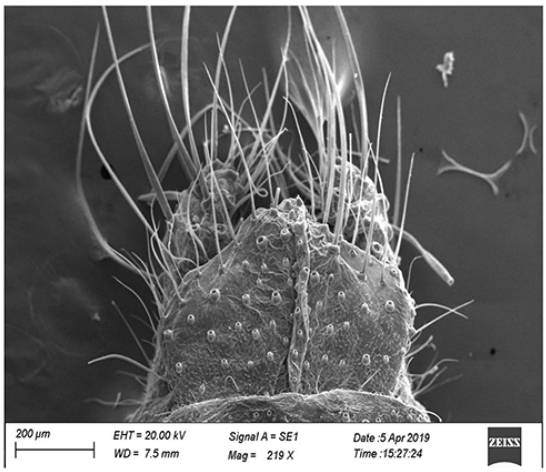
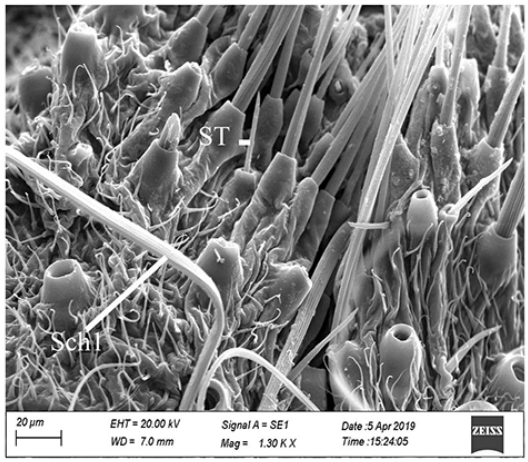


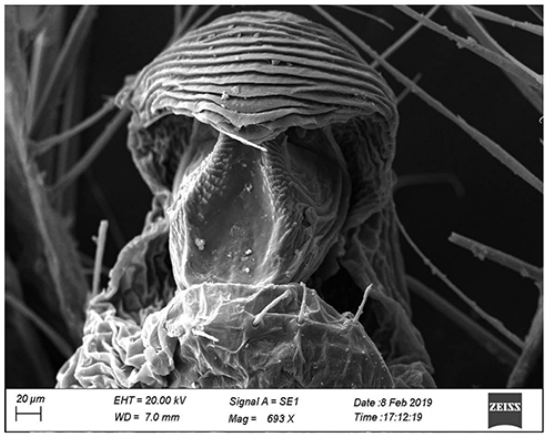
Plate 1. (Figures 1-4). Male genitalia of *Myrmecaelurus acerbus* (Walker, 1853). **1.** Lateral view, **2.** Gonocoxites IX and XI (ventral view). Female genitalia of *Myrmecaelurus acerbus* (Walker, 1853). **3.** Lateral view, **4.** Ventral view.



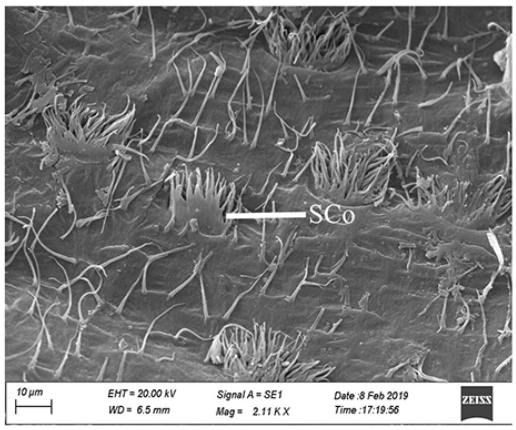
5



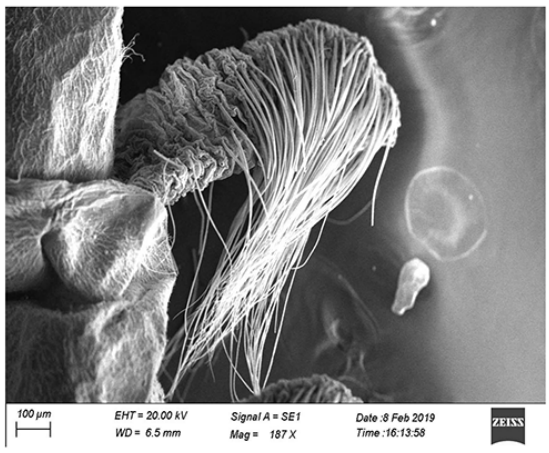
6



7

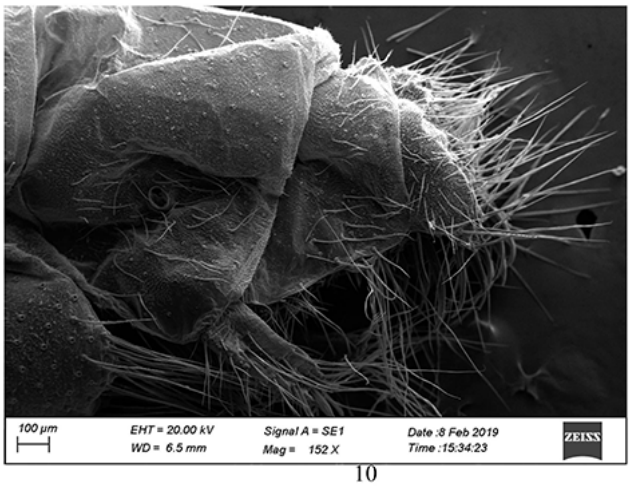


8

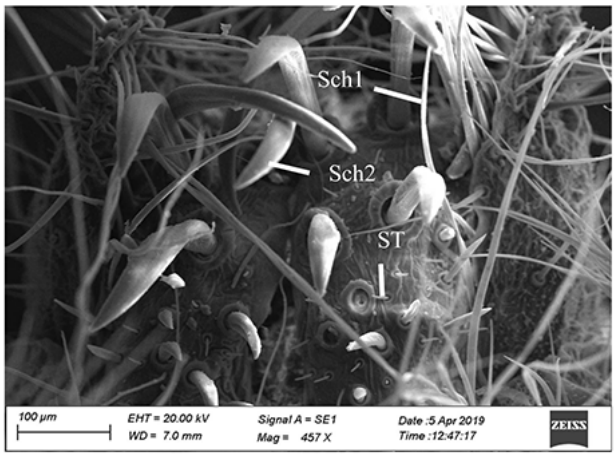


9

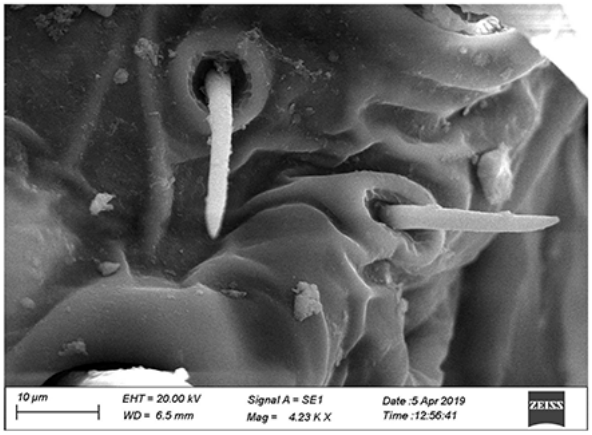
Plate 2. (Figures 5-9) SEM micrographs of male genitalia of *Myrmecaelurus acerbus* (Walker, 1853). **5.** Dorsal view, **6.** Left Pleuritosquama on abdominal segment 6, **7.** Magnified part of sterum IX. **8.** Gonocoxite IX. **9.** Sensilla coeloconica on gonocoxite XI, dorsal view.



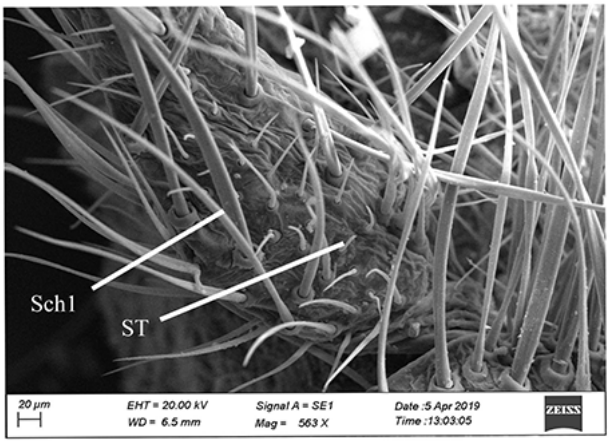
10



11



12



13

Plate 3. (Figures 10-13) SEM micrographs of female genitalia of *Myrmecaelurus acerbus* (Walker, 1853). **10.** Lateral view. **11.** Magnified part of gonocoxite IX, **12.** Sensilla trichoidea on gonocoxite IX, **13.** Magnified part of gonocoxite VIII.